

**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION  
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :

C08J 5/12, C09J 7/02, B32B 27/08

A1

(11) International Publication Number:

WO 96/25453

(43) International Publication Date:

22 August 1996 (22.08.96)

(21) International Application Number: PCT/US96/01952

(22) International Filing Date: 15 February 1996 (15.02.96)

(30) Priority Data:

08/390,182

17 February 1995 (17.02.95)

US

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(US).(81) Designated States: CA, JP, KR, MX, European patent (AT,  
BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL,  
PT, SE).

Published

With international search report.

(54) Title: ADHESIVE FILM

(57) Abstract

The present invention provides an adhesive film and method for bonding a polymeric skin to a rigid thermoplastic substrate such as a vehicle interior door panel. The adhesive film may include one or two adhesive layers and a thermoformable base layer. The base layer functions as a barrier layer to prevent the adhesive bond between the polymeric skin and substrate from being affected by migration of plasticizers from the skin. In a preferred embodiment, the adhesive film is adhered to the vinyl skin and then bonded to the substrate by a vacuum thermoforming process.

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## ADHESIVE FILM

The present invention relates to an adhesive film for bonding a polymeric skin to a thermoplastic substrate, and more particularly, the invention relates to an adhesive film and method for bonding a vinyl skin to a rigid thermoplastic substrate such as a vehicle door panel.

In the automotive industry, it is common to use a rigid thermoplastic substrate in constructing automotive interior trim components such as door panels. Such door panel substrates are generally provided with openings to accommodate door handles, door lock connections, electric window control buttons, and the like. Generally, the finished door panel comprises an exterior vinyl skin bonded to a rigid thermoplastic substrate. Such door panels are typically formed by spraying a water or solvent-based adhesive onto an injection molded door panel substrate, allowing the adhesive to dry, and then thermoforming a vinyl skin onto the adhesive-covered panel.

However, the use of spray adhesives for bonding vinyl to a thermoplastic substrate suffers from a number of drawbacks. First, the use of spray adhesives is labor intensive and therefore costly. Further, the use of spray adhesives often results in nonuniform thickness and distribution of the adhesive across the surface of a thermoplastic substrate, which in turn results in nonuniform bond strength across the resulting component. In addition, because of the openings in the substrates and the need to apply adhesive over the entire surface of the substrate, a portion of the spray adhesive goes through the openings or past the edges and is wasted. Further, if the vinyl skin is not adhered to the substrate within 2-4 hours after the adhesive is applied, the substrate may have to be discarded or recycled, resulting in additional expense. Another disadvantage of such spray adhesives is that the adhesives often utilize solvents, which are environmentally undesirable and which require additional clean-up costs.

In addition, after the vinyl skin is bonded to the door panel substrate, it has been found that plasticizers in the exterior vinyl skin tend to migrate and can attack the adhesive or substrate, weakening the bond between the vinyl skin and the substrate.

Accordingly, there is still a need in the art for a method and product for effectively bonding a polymeric skin to a rigid thermoplastic substrate, such as a vehicle door panel, without the use of spray adhesives or solvent-containing adhesives. Further, there is still a need in the art for a method and product

which is less costly to produce, provides uniform adhesive bonding of composite parts, which reduces waste and clean-up problems, and which resists the permeation and damaging effect of plasticizers.

The present invention meets those needs by providing an adhesive film and method of application which may be used to effectively bond a polymeric skin such as vinyl to a rigid thermoplastic substrate such as a substrate used in a vehicle interior door panel. The use of the adhesive film provides a uniform thickness and distribution of adhesive across the substrate, reduces waste, and involves no spraying of adhesives or solvents into the environment. Further, the use of the adhesive film prevents plasticizers in the vinyl skin from attacking the adhesive or substrate.

According to one aspect of the present invention, an adhesive film for bonding a polymeric skin to a rigid thermoplastic substrate is provided. The adhesive film preferably has a bond strength when adhered to the substrate of at least 1-20 lb/inch-width (.18 - 4 kg/cm), and more preferably, at least 5 lb/inch-width (.90 kg/cm).

The adhesive film includes a first adhesive layer, a second adhesive layer, and a thermoformable base layer therebetween. Preferably, the adhesive layers are selected from the group consisting of copolyester hot melt resins, copolyamide hot melt resins, ethylene-vinyl acetate-carbon monoxide copolymer resins, polyethylene-graft maleic anhydride resins, ethylene acrylic acid copolymer resins, ethylene vinyl acetate, ethylene methyl acrylate, polyester elastomers, and substantially linear ethylene polymers. In a preferred embodiment of the invention, the first adhesive layer is adherable to the polymeric skin and the second adhesive layer is adherable to the rigid thermoplastic substrate.

The base layer is preferably selected from the group consisting of ethylene acrylic acid copolymer resins, ionomer-modified polyethylene resins, nylon, and substantially linear ethylene polymers. In a preferred embodiment of the invention, the base layer also functions as a barrier layer to prevent the adhesive bond between the skin and substrate from being affected by migration of plasticizers from the vinyl skin.

In another embodiment of the invention, a composite is provided comprising a polymeric skin having a front face and a rear face and a monolayer adhesive film having a first surface and a second surface, where the first surface of the adhesive film is adhered to the rear face of the polymeric skin. The adhesive film is selected from the group consisting of copolyester hot melt resins, copolyamide hot melt resins, ethylene-vinyl acetate-

carbon monoxide copolymer resins, polyethylene-graft maleic anhydride resins, ethylene acrylic acid copolymer resins, ethylene vinyl acetate, ethylene methyl acrylate, polyester elastomers, and substantially linear ethylene polymers.

A removable release liner may optionally be adhered to the second surface of the adhesive film. This permits the composite to be stored in roll form until needed.

The present invention also provides a method of making a composite comprising a vinyl skin, a substrate, and an adhesive film therebetween bonding the vinyl skin to the substrate. The method of making the composite comprises the steps of adhering the first surface of the adhesive film to the rear face of the vinyl skin, and then bonding the vinyl skin having the adhesive film adhered thereto to a substrate. The substrate may be, for example, a rigid thermoplastic which may be assembled into a vehicle door panel.

The adhesive film is selected from the group of resins described above and is preferably adhered to the vinyl skin by thermally laminating the adhesive film onto the vinyl skin as a 100% solids hot melt adhesive. Alternatively, the adhesive film may be extrusion coated onto the vinyl skin. This process results in a smooth, uniform thickness of adhesive across the surface of the vinyl skin. Preferably, the vinyl skin is bonded to the substrate by heating the vinyl skin having the adhesive film adhered thereto, and then thermoforming the vinyl skin onto the substrate. The adhesive film provides a bond strength to the substrate in the resulting composite of at least 1-20 lb/inch-width (.18 - 4 kg/cm).

The adhesive film in the resulting composite may also include a first adhesive layer, a second adhesive layer, and a base layer therebetween, where the first adhesive layer adheres to the vinyl skin, and the second adhesive layer adheres to the substrate. In an alternative embodiment, a removable release liner may be adhered to the second surface of the adhesive film which permits the composite to be stored in roll form. In this embodiment, the release liner is removed from the adhesive film prior to the step of bonding the vinyl skin to the substrate.

Accordingly, it is a feature of the present invention to provide an adhesive film for bonding a polymeric skin to a rigid thermoplastic substrate such as a vehicle door panel which provides a uniform thickness and distribution of adhesive across the substrate and which resists the damaging effect of plasticizers. It is a further feature of the invention to provide a method of making a composite structure such as a vehicle

door panel which utilizes the adhesive film. These, and other features and advantages of the present invention, will become apparent from the following detailed description, the accompanying drawings, and the appended claims:

Fig. 1 is a cross-sectional view of one embodiment of the adhesive film of the present invention showing adhesive and base layers;

Fig. 2 is a cross-sectional view of a composite structure including a vinyl skin and adhesive film;

Fig. 3 illustrates an alternative embodiment of the invention in which the adhesive film is a monolayer film;

Fig. 4 is a cross-sectional view of a composite structure including a vinyl skin, adhesive film, and substrate; and

Fig. 5 is a perspective view of a vehicle door panel made in accordance with the present invention.

The adhesive film of the present invention provides a number of advantages over previously used methods which utilize spray adhesives. For example, the adhesive film adheres a vinyl or other polymer skin to a thermoplastic substrate such as a door panel by, for example, a vacuum thermoforming process, thus eliminating the need for spray adhesives. The adhesive film also provides a uniform thickness and distribution of adhesive on the vinyl skin. Because the adhesive film is adhered first to the vinyl skin, a cost savings is obtained over spray adhesives which are applied to the substrate and wasted through uneven application and leakage through openings in the substrate. In addition, the inclusion of a barrier material such as nylon in the base layer of the adhesive film provides a barrier to plasticizer migration from the vinyl skin to the substrate surface, thus preventing possible plasticizer attack on the adhesive or substrate, and maintaining an effective bond between the skin and substrate.

The adhesive film for use in the present invention should be capable of adhering a polymeric skin to a rigid thermoplastic substrate. The adhesive film should also exhibit a bond strength when adhered to a substrate of at least 1-20 lb/inch-width (.18 - 4 kg/cm), and more preferably, at least 5 lb/inch-width (.90 kg/cm). Preferred resins for use as the adhesive layers of the film include Dynapol® S1248, S1252 and S1227, and

S1401 copolyester hot melt adhesive resins available from Huls America, Uni-Rez® 2633 and 2642 copolyamide hot melt adhesive resins available from Union Camp, BYNEL CXA 1123 coextrudable adhesive resin, Elvaloy® 4294 ethylene-vinyl acetate-carbon monoxide copolymer resin available from duPont, Plexar® 3342 polyethylene-graft maleic anhydride resin available from Quantum Chemical, and HYTREL® 4056 polyester elastomer from Dupont.

In addition, substantially linear ethylene polymers made by using Insite™ constrained geometry catalyst technology (CGCT) such as Affinity™ resins, available from The Dow Chemical Company exhibit good adhesion to various thermoplastics. Such resins are taught in commonly-assigned U.S. Patent Nos. 5,272,236 and 5,278,272, the disclosures of which are hereby incorporated by reference. As used herein, "substantially linear" means that the polymer backbone is substituted with from 0.01 to 3 long-chain branches/1000 carbon atoms. While the substantially linear ethylene polymers used in the practice of this invention include homopolymers of ethylene, preferably the substantially linear ethylene polymers include from 5 to 50% by weight of at least one  $\alpha$ -olefin comonomer as taught in the above-referenced patents.

The adhesive film of the present invention has been found to exhibit good adhesion to vehicle door panels comprised of rigid engineering plastics such as acrylonitrile-butadiene styrene (ABS), styrene-maleic anhydride (SMA), polyphenylene oxide (PPO), and polycarbonate/acrylonitrile-butadiene styrene (PC/ABS) blends, high impact polystyrene (PS) and surface treated polypropylene (PP). However, it should be appreciated that the adhesive film of the present invention may be used for a variety of other applications where it is desirable to bond a polymeric skin to a substrate.

Referring now to Fig. 1, the adhesive film 10 of the present invention is shown as a three-layer film which includes a first adhesive layer 14, a thermoformable base layer 12, and a second adhesive layer 16. Preferably, the first adhesive layer 14 is adherable to a vinyl skin and the second adhesive layer 16 is adherable to a thermoplastic substrate (see Fig. 4). We have found that the same adhesives may be used for both layers 14 and 16 as such adhesives bond well to typical substrates currently used in the automotive industry. For example, an adhesive film of a copolyester, copolyamide or Affinity™ resin provides strong adhesive bonds. Of course, it will be recognized that some adhesives will provide stronger bonds with certain vinyl materials or substrates. It will also be appreciated that, depending on the materials selected for the base and adhesive layer or layers, the use of a tie layer material may be desirable to insure the cohesiveness of the multilayer film. Such tie layer materials are well known in the art.

The base layer is preferably selected from the group consisting of ethylene acrylic acid copolymer resins, ionomer-modified polyethylene resins, nylon, and substantially linear ethylene polymers. Preferred films for use as the base or barrier layer are Nylon 6, amorphous nylons, nylon blends, polymethyl methacrylate, polyethylene terephthalate such as Mylar<sup>TM</sup> available from DuPont, PAPHEN<sup>TM</sup> Phenoxy resin (PKFE), available from Phenoxy Associates, and polyethylene terephthalate glycol (PETG). Other suitable films include an ethylene acrylic acid copolymer such as Primacor<sup>TM</sup> 1410 available from The Dow Chemical Company or an ionomer based film.

The use of a barrier material such as nylon or nylon blends has been found to provide the best barrier to block plasticizer migration from the vinyl skin and reduce its effect on adhesive bond strength. To form the multilayer adhesive film, the adhesive layer may be coated onto or coextruded with the base layer.

Fig. 2 illustrates an embodiment of the invention in which the adhesive film 10 is a two-layer film comprising adhesive layer 14 and base layer 12. The adhesive film 10 is included in a composite structure comprising a vinyl skin 18 having a front face 22 and a rear face 24. The adhesive film 10 has a first surface 28 and a second surface 30 and, as shown, the first surface 28 of the adhesive film is adhered to the rear face 24 of the vinyl skin.

Fig. 3 illustrates an alternative embodiment in which the adhesive film is a monolayer film comprised of adhesive layer 14. In the embodiment shown, a removable release liner 26 is adhered to the second surface 30 of the adhesive film. The release liner is preferably comprised of low or high density polyethylene.

Fig. 4 illustrates a composite structure including a three-layer adhesive film 10, vinyl skin 18, and a substrate 32. The substrate 32 shown in Fig. 4 may be a door panel (see Fig. 5). As shown, the substrate includes openings 34 which may be found on a door panel substrate to accommodate door handles, locks, etc. The adhesive film 10 includes first adhesive layer 14 which is adhered to the vinyl skin 18, second adhesive layer 16 which is adhered to the substrate 32, and base layer 12.

The composite shown in Fig. 4 is preferably formed by first adhering the first surface 28 of the adhesive film to the rear face 24 of the vinyl skin. This may be done by laminating the adhesive film onto the



vinyl skin as a 100% solids hot melt adhesive. Alternatively, the adhesive film may be adhered to the vinyl skin by extrusion coating the adhesive film onto the vinyl skin.

The vinyl skin having the adhesive film adhered thereto is then bonded to the substrate 32. This is preferably done by a conventional vacuum thermoforming process in which the adhesive film 10 on the vinyl skin 18 is heated to soften the film and activate the adhesive layer and is then bonded to the substrate 32. However, other thermal and pressure bonding processes may be utilized. The vinyl skin is preferably thermally bonded to the substrate at 250-400°F (121-204°C) and 5-40 psi (.35 - 3 kg/sq.cm) for 5-30 seconds. Fig. 5 illustrates an example of a vehicle door panel 38 formed by the process of the present invention. However, it should be appreciated that this process may be used in a variety of other applications where it is desired to bond a polymeric material to a rigid thermoplastic substrate.

In order that the invention may be more readily understood, reference is made to the following example, which is intended to be illustrative of the invention, but is not intended to be limiting in scope.

#### Example 1

An adhesive film comprising an adhesive layer having a thickness of from 2-3 mils (50.8 - 76.29µm) was adhered to a vinyl skin in accordance with the present invention. The adhesive film on the vinyl skin was then heat activated and the vinyl skin bonded to a rigid thermoplastic substrate to form a composite. The resulting bond strengths of the adhesive film to the vinyl skin and substrate are recorded in Tables 1 and 2 below.

Table 1

		<u>Bond Strength</u> (lb/inch-width by 180° peel at 12 in./min.) (30.48cm/min)	
<u>Substrate</u>	<u>Adhesive Film</u>		
5	Magnum 334HP <sup>1</sup>	Dynapol S1252 <sup>2</sup>	15.3 (273.23 kg/cm)
	Magnum 334HP <sup>1</sup>	Dynapol S1227 <sup>2</sup>	10.2 (182.15 kg/cm)
	Magnum 342EZ <sup>1</sup>	Dynapol S1252 <sup>2</sup>	8.8 (157.15 kg/cm)
	Magnum 342EZ <sup>1</sup>	Dynapol S1227 <sup>2</sup>	6.4 (114.29 kg/cm)
10	Magnum 445HQ <sup>1</sup>	Dynapol S1252 <sup>2</sup>	10.5 (187.51 kg/cm)
	Magnum 445HQ <sup>1</sup>	Dynapol S1227 <sup>2</sup>	6.2 (110.72 kg/cm)
	Magnum 445HQ <sup>1</sup>	Plexar 3342 <sup>3</sup>	5.6 (100.00 kg/cm)
	Magnum 445HQ <sup>1</sup>	Elvaloy 4924 <sup>4</sup>	16.1 (287.51 kg/cm)
	Magnum 445HQ <sup>1</sup>	BYNEL 1123 <sup>5</sup>	6.5 (116.08 kg/cm)
15	Rubber modified polystyrene <sup>6</sup>	Dynapol S1252 <sup>2</sup>	10.2 (182.15 kg/cm)
	Pulse B250 <sup>7</sup>	Dynapol S1252 <sup>2</sup>	11.0 (196.44 kg/cm)
	Pulse B250 <sup>7</sup>	Unirez 2633 <sup>8</sup>	8.2 (146.44 kg/cm)
	Calibre 117401-18 <sup>9</sup>	Dynapol S1252 <sup>2</sup>	20.0 (357.16 kg/cm)
20	Calibre 117401-18 <sup>9</sup>	Dynapol S1227 <sup>2</sup>	20.0 (357.16 kg/cm)
	Calibre 117401-18 <sup>9</sup>	Unirez 2633 <sup>8</sup>	6.3 (112.51 kg/cm)
	Profax PD064 <sup>10</sup>	Plexar 3342 <sup>3</sup>	5.3 (94.65 kg/cm)
	Noryl N300 <sup>11</sup>	Affinity PL1180 <sup>12</sup>	9.9 (176.79 kg/cm)
	Noryl N300 <sup>11</sup>	Affinity PL1140 <sup>12</sup>	8.3 (148.22 kg/cm)
25	Noryl 7301F <sup>11</sup>	Plexar 3342 <sup>3</sup>	6.0 (107.15 kg/cm)
	Dylark 387 <sup>13</sup>	Dynapol S1252 <sup>2</sup>	6.1 (108.93 kg/cm)
	Dylark 387 <sup>13</sup>	Unirez 2633 <sup>8</sup>	15.8 (282.16 kg/cm)

30

<sup>1</sup>Acrylonitrile butadiene styrene (ABS) from The Dow Chemical Company<sup>2</sup>Co-polyester from Huls America.<sup>3</sup>Graft maleic anhydride from Quantum Chemicals.<sup>4</sup>Ethylene vinyl acetate/carbon monoxide terpolymer from DuPont.35 <sup>5</sup>Coextrudable adhesive tie layer polymer from DuPont.<sup>6</sup>Rubber modified polystyrene from The Dow Chemical Company.<sup>7</sup>Polycarbonate/acrylonitrile butadiene styrene blend from The Dow Chemical Company.<sup>8</sup>Co-polyamide from Union Camp.<sup>9</sup>Polycarbonate from The Dow Chemical Company.40 <sup>10</sup>Polypropylene from Himont<sup>11</sup>Polyphenylene oxide from GE Plastics.<sup>12</sup>Polyolefin Plastomer from The Dow Chemical Company.<sup>13</sup>Styrene maleic anhydride from Arco.

45 All samples heat sealed at 350°F (176.7°C) and 20 psi for 15 seconds.

Table 2

5	<u>Polymer Skin</u>	<u>Adhesive Film</u>	<u>Bond Strength</u> <u>(lb/inch-width by 180°</u> <u>peel at 12 in./min.) (30.48cm/min)</u>
10	Polyvinyl chloride (PVC) PVC PVC PVC PVC/acrylonitrile butadiene styrene (ABS) (Type A)	Dynapol S1252 <sup>1</sup> Dynapol S1227 <sup>1</sup> Unirez 2633 <sup>2</sup> Plexar 3342 <sup>3</sup> Elvaloy 4924 <sup>4</sup> Dynapol S1252 <sup>1</sup>	9.2 (164.29 kg/cm) 10.2 (182.15 kg/cm) 7.9 (141.08 kg/cm) 15.0 (267.87 kg/cm) 15.0 (267.87 kg/cm) 17.0 (303.59 kg/cm)
15	PVC/ABS (Type A) PVC/ABS (Type A) PVC/ABS (Type B) PVC/ABS (Type B)	Dynapol S1227 <sup>1</sup> Unirez 2633 <sup>2</sup> Dynapol S1252 <sup>1</sup> Dynapol S1227 <sup>1</sup>	10.4 (185.72 kg/cm) 7.9 (141.08 kg/cm) 18.9 (337.52 kg/cm) 12.8 (228.58 kg/cm)
20	PVC/ABS (Type C) PVC/ABS (Type C) PVC/ABS (Type D) PVC/ABS (Type D)	Dynapol S1252 <sup>1</sup> Dynapol S1227 <sup>1</sup> Dynapol S1252 <sup>1</sup> Dynapol S1227 <sup>1</sup>	18.7 (333.94 kg/cm) 20.0 (357.16 kg/cm) 17.7 (316.09 kg/cm) 11.9 (212.51 kg/cm)
25	PVC/ABS (Type D) PVC/ABS (Type D) PVC/ABS (Type E) PVC/ABS (Type E)	Unirez 2633 <sup>2</sup> Plexar 3342 <sup>3</sup> Elvaloy 4924 <sup>4</sup> Dynapol S1252 <sup>1</sup>	7.1 (126.79 kg/cm) 7.4 (132.15 kg/cm) 15.0 (267.87 kg/cm) 12.2 (217.87 kg/cm)
30	PVC/ABS (Type E)	Dynapol S1227 <sup>1</sup> Unirez 2633 <sup>2</sup>	12.9 (230.37 kg/cm) 7.5 (133.93 kg/cm)

35 <sup>1</sup>Co-polyester from Huls America.

<sup>2</sup>Co-polyamide from Union Camp.

<sup>3</sup>Graft maleic anhydride from Quantum Chemicals.

<sup>4</sup>Ethylene vinyl acetate/carbon monoxide terpolymer from DuPont.

40 All samples heat sealed at 350°F (176.7°C) and 30 psi for 50 seconds

While certain representative embodiments and details have been shown for purposes of illustrating the invention, it will be apparent to those skilled in the art that various changes in the methods and apparatus disclosed herein may be made without departing from the scope of the invention, which is defined in the appended claims.

1. An adhesive film for bonding a polymeric skin to a rigid thermoplastic substrate, said adhesive film including a first adhesive layer, a second adhesive layer, and a thermoformable base layer therebetween, said adhesive film having a bond strength when  
5 adhered to said substrate of at least 1-20 lb/inch-width (.18 - 4 kg/cm).

2. The adhesive film of claim 1 wherein said bond strength is at least 5 lb/inch-width (.90 kg/cm).

10 3. The adhesive film of claim 1 in which said first and second adhesive layers are selected from the group consisting of copolyester hot melt resins, copolyamide hot melt resins, ethylene-vinyl acetate-carbon monoxide copolymer resins, polyethylene-graft maleic anhydride resins, ethylene acrylic acid copolymer resins, ethylene vinyl acetate, ethylene methyl acrylate, polyester elastomers, and substantially linear ethylene polymers.

15 4. The adhesive film of claim 1 in which said base layer is selected from the group consisting of ethylene acrylic acid copolymer resins, ionomer-modified polyethylene resins, nylon, and substantially linear ethylene polymers.

20 5. The adhesive film of claim 1 in which said first adhesive layer is adherable to said polymeric skin, and said second adhesive layer is adherable to said rigid thermoplastic substrate.

25 6. A composite comprising a vinyl skin having a front face and a rear face and an adhesive film having a first surface and a second surface, wherein said first surface of said adhesive film is adhered to said rear face of said vinyl skin, and wherein said adhesive film is selected from the group consisting of copolyester hot melt resins, copolyamide hot melt resins, ethylene-vinyl acetate-carbon monoxide copolymer resins, polyethylene-graft maleic anhydride resins, ethylene acrylic acid copolymer resins, ethylene vinyl acetate,  
30 ethylene methyl acrylate, polyester elastomers, and substantially linear ethylene polymers.

7. The composite of claim 6 including a removable release liner adhered to the second surface of said adhesive film.

8. A composite comprising a vinyl skin, a rigid thermoplastic substrate, and an adhesive film therebetween bonding said vinyl skin to said substrate, said adhesive film having a bond strength to said substrate of at least 1-20 lb/inch-width (.18 - 4 kg/cm).

5 9. A method of making a composite of a vinyl skin and a substrate comprising the steps of:

- a) providing a vinyl skin having a front face and a rear face;
- b) providing an adhesive film having a first surface and a second surface;
- c) adhering said first surface of said adhesive film to said rear face of said vinyl skin; and
- d) bonding said vinyl skin with said adhesive film adhered thereto to a substrate, said adhesive film having a bond strength when adhered to said substrate of at least 1-20 lb/inch-width (.18 - 4 kg/cm).

10 11. The method of claim 9 in which said substrate is a rigid thermoplastic.

15 12. The method of claim 9 wherein said substrate is an acrylonitrile-butadiene-styrene copolymer.

20 13. The method of claim 9 in which said substrate is a vehicle interior door panel.

25 14. The method of claim 9 in which said adhesive film is selected from the group consisting of copolyester hot melt resins, copolyamide hot melt resins, ethylene-vinyl acetate- carbon monoxide copolymer resins, polyethylene-graft maleic anhydride resins, ethylene acrylic acid copolymer resins, ethylene vinyl acetate, ethylene methyl acrylate, polyester elastomers, and substantially linear ethylene polymers.

30 15. The method of claim 14 in which said adhesive film includes a base layer and an adhesive layer.

16. The method of claim 15 in which said base layer is thermoformable.

16. The method of claim 14 in which said base layer is selected from the group consisting of ethylene acrylic acid copolymer resins, ionomer-modified polyethylene resins, nylon, and substantially linear ethylene polymers.

5 17. The method of claim 9 in which said adhesive film includes a first adhesive layer adherable to said vinyl skin, a second adhesive layer adherable to said substrate, and a base layer therebetween.

10 18. The method of claim 9 in which said adhesive film includes a removable release liner adhered to said second surface of said adhesive film, and wherein said release liner is removed from said adhesive film prior to bonding said vinyl to said substrate.

15 19. The method of claim 9 in which said adhesive film is adhered to said vinyl skin by laminating said adhesive film onto said vinyl skin as a 100% solids hot melt adhesive.

20. The method of claim 9 in which said adhesive film is adhered to said vinyl skin by extrusion coating said adhesive film onto said vinyl skin.

20 21. The method of claim 9 in which the step of bonding said vinyl skin to said substrate includes the step of heating said vinyl skin having said adhesive film adhered thereto and thermoforming said vinyl skin onto said substrate.

25 22. The method of claim 21 in which said vinyl skin is bonded to said substrate at 250-400°F (121-204°C) and 5-40 psi (.35 -3 kg/sq.cm) for 5-30 seconds.

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FIG - 1

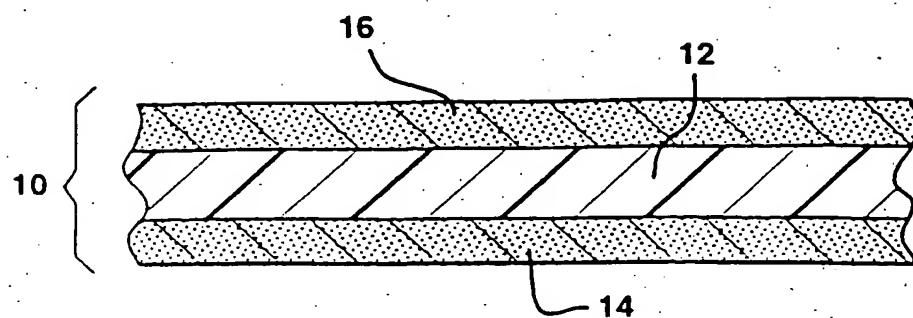


FIG - 2

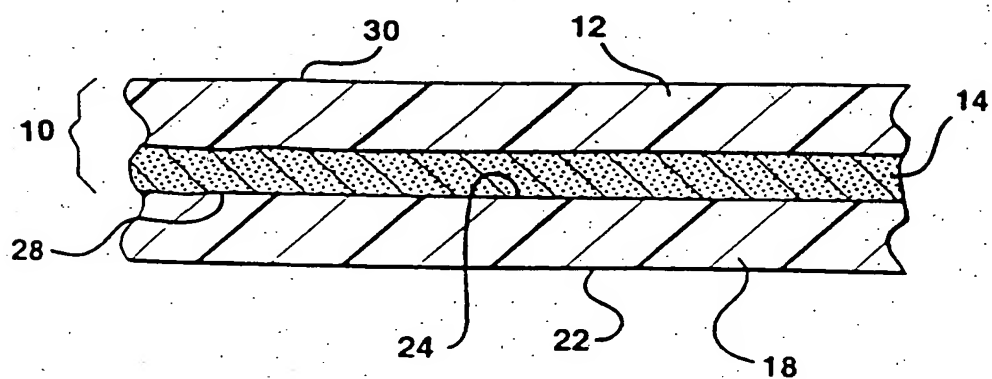
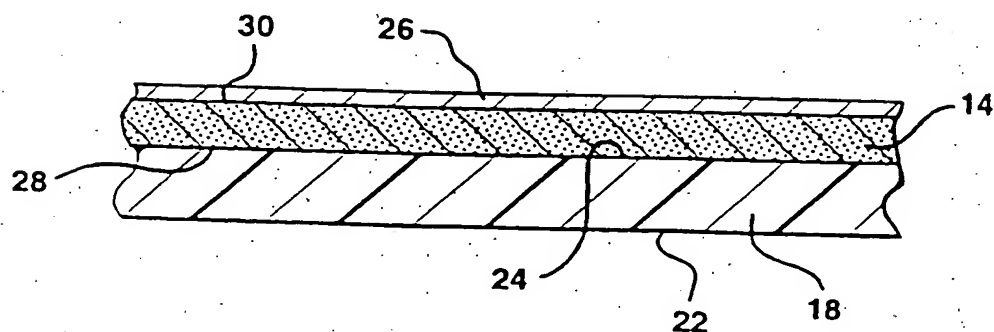


FIG - 3







# INTERNATIONAL SEARCH REPORT

Int. Application No.

PCT/US 96/01952

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 C08J5/12 C09J7/02 B32B27/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 C08J C09J B32B

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US,A,3 703 434 (R.L. SCHAAF) 21 November 1972  see claim 1 see table 1	1,4,5  1-5
X Y Y	US,A,3 690 936 (R.C. DOSS ET AL.) 12 September 1972  see claim 1 see table 1  -/-	1-6  1-5 9,13

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

15 May 1996

Date of mailing of the international search report

05.06.96

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# INTERNATIONAL SEARCH REPORT

Int. Application No.  
PCT/US 96/01952

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR,A,2 582 691 (SOLVAY & CIE) 5 December 1986	1,8-12, 21,22
Y	see claims 1,10 see page 5, line 23 - page 6, line 20 see page 8, line 31 - page 10	9,13
A	EP,A,0 103 407 (MINNESOTA MINING AND MANUFACTURING COMPANY) 21 March 1984 see claims 1,9 see example 1	6,7,9,18

# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/US 96/01952

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